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Bonded Sawdust as a Substitute Material for Carving

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Abstract:
Wood carving as an art has from time immemorial been used to promote, preserve and invigorate Ghanaian culture. However, the stock of some of the preferred tree species used for carving is declining at an alarming rate. The need to ensure the sustainability of the wood carving industry therefore motivated the researchers to find a solution to this problem. The researchers experimented with a recyclable material that could be used for carving instead of the conventional wood. The research experimented with White glue and Sawdust to build blocks which served as carving materials in place of conventional wood. The purpose of the study was to research into the viability of sawdust as a carving material. This research was determined to come up with a substitute material for wood carving, and was specifically concerned with a comprehensive investigation into the viability of sawdust. The study investigated, experimented and taught students how to produce boards from the sawdust blocks. The research discuses, describes and analyses into detail the experiments conducted. The research uses qualitative research and further makes use of quasi-experimental, action and descriptive research designs. The results of the study suggest that ''sawdust block'' can be carved. The study also revealed that even though sawdust blocks could be carved, its finishing cannot be compared to conventional wood. The study recommends that the use of sawdust as an alternative carving material should be introduced and taught in all sculpture departments in Senior High Schools and tertiary institutions.

Keywords: *Sawdust, sculpture, carving*

1. Introduction

In spite of the countless number of environmental campaigns, both locally and internationally, the rich forest lands continue to deplete at a threatening speed (Okra 2002). The timber industry is widely opening up and as a result, it is adversely adding to deforestation. Dei (1990) was of the view that even though there is no data on the quantity of wood felled for carving, wood carving activities contribute immensely to the alarming rate of deforestation in Ghana.

Okra (2002), shares that the government of Ghana's 15-Year Tourism Master Plan (1996-2010) called for the development and promotion of the traditional carving industry's internal and overseas markets. This has obviously resulted in a surge in the use of wood for carving. Consequently, there has been an unprecedented depletion of the stock of the tree species used for carving.

He buttresses Dei's point stating that "woodcarving industry has thus become a key player in the deforestation of Ghana". Wood resources are depleting at a faster rate as a result of unsustainable practices in the production and marketing of the wood products. It is also sad to note that a significant component of wood is left to waste away during production. According to the UN Food and Agriculture Organisation (FAO 2010) the rate of deforestation in Ghana is 3% per annum. Duku, Gu and Hagan (2011) reported that wood processing waste generated in the year 2008 alone totalled one hundred and twenty-eight thousand, two hundred and fifty (128,250) tonnes of sawn wood. In the year 1988, UNDP/World Bank Energy Management Assistance Programme on Sawmill Residue Utilisation reported that sawdust accounted for 21% of the total mill waste in Ghana.

A cursory look at the operations of the traditional carving industry in Kumasi revealed a consistent mounting pressure on the few remaining tree species that have been used for carving since time immemorial. Some of these tree species are; "Sese", "Ebony", "Danta", "Kusia" et cetera. The imbalance between demand and supply poses a bleak future for this traditional industry. As a country,

we do not have the luxury of time but to act fast to salvage the collapse of this vital local industry. There is therefore, the need to find a workable and action driven solution to the problem.

The many wood processing firms in this country cause so much waste that we do not have the capacity to dispose of them at the moment. Factoring in the importance of the existence of the wood carving industry as well as ensuring environmental sustainability, this project seeks to reuse these wood wastes for boards that could be used for carving. Here, sawdust is processed into an appropriate material that could be used in woodcarving. The researchers embarked upon this project with students in the Visual Art Department of the Armed Forces Senior High School in the Kumasi metropolis.

1.1. Sawdust

Waste is generally defined as the failure to recover the value inherent in a given amount of raw material. Marfo (2010) defined wood waste as any wood that has no longer any value at its present location. In this regard, wood waste could therefore come about as off-cuts, shavings, mill residue and sawdust; through observation asserts that sawdust is classified as a wood waste.

According to Marfo (2010), wood waste occurs not only during logging operations but also during secondary processing. He further stated that wood waste occurs in the forest as logging waste and occurs as mill waste in the form of sawdust, off-cuts, trimmings, slab edgings and veneer cores. Wood processing wastes such as discarded logs, bark, sawdust, off-cuts, etc., on the other hand, are generated through sawmill and plywood mill processing activities. Duku et al, (2011, p. 410) contend that, "generally, sawmills in Ghana have recovery rates ranging from 20% to 40% of the log input, averaging 33.3%". As cited in Duku et al, the FAO estimated that wood processing wastes generated in the year 2008 totalled 256,000 m3, equivalent to hundred and twenty eight thousand two hundred and fifty (128,250) tonnes, based on sawn wood production for 2008. This assertion reveals how sawdust, a regenerative material is left to go waste.

Another report by UNDP/World Bank Energy Sector Management Assistance Project on Sawmill Residue Utilisation in 1988 indicated that sawdust alone accounted for 21% of the total residues generated. In this light, sawdust could also be said to be the volumes of unrecovered saw offcuts produced as a result of wood processing either in the preliminary or secondary stages.

It may also be classified as one of the many kinds of residues produced after wood or timber has been economically exhausted. Off-cuts as a result of wood processing activities may vary in sizes and density depending on the machine that is used in the process.

In this study, sawn off-cuts would be the researchers focus. Owing to varied saw blades, even this category of wood waste may be further varied according to size of individual sawdust particles. They may range from powdery smooth to gravel coarse particles.

Their colour may also range from white to dark brown depending on the parent timber from which the off cut was made. Sawdust is abundantly available at saw mills and carpentry shops.

1.2. Particle Board

Generally, particle boards are flake boards that can be manufactured from organic materials such as rice husk, wood waste, coconut fruit fibre and the likes. Wood particle boards are manufactured from dry wood particles that have been bonded with a binder resin, and are bonded together with pressure and heat. Wood particles for the manufacture of particleboard can be made from almost any type of wood. It could also be made from any form of wood residue such as trimmings and shavings from lumber or plywood manufacturing (Carl, 1986). Particle board is produced from industrial wood residues such as shavings, sawdust, plywood trim, fines, and chips and can be produced from log and urban wood waste chips (Wilson 2009). These wood particles are bonded with glue present in concentration of 5% and 18% (Larson et al., 1997).

Particle board, a non-structural panel product which was developed in the 1950s used industrial wood residue from the production of primary wood products like lumber and plywood. These wood residues were previously burnt or sent to a landfill for disposal as waste material. Over the years, the product has evolved into a highly engineered product designed to meet specific end-use requirements. According to Wilson (2009) Particle board is produced from industrial wood residues that are refined to small particles that are dried, blended with resin and wax, formed into a mat that is consolidated and cured under pressure and heat, sawn to dimension, and sanded to thickness.

Particle board is produced to densities ranging from about 600 –800 kg/m3. Although "lower density woods are preferred" almost any wood species can be used for particle board production. The term particleboard may also be referred to as a "chip board", "flake board", "strand-board" or "wafer-board" (Carl, 1986).

Wilson (2009) revealed that 96% of particle board is produced for making household and office furniture, kitchen and other domestic products. He further indicated that it is only 4% of particleboard that are used for flooring purposes.

- The Strength of Particle Board (Bonded Sawdust)

The strength of particle board primarily depends on the chemical content of the parent wood and binding agent during the production process. Chemical modification could improve the dimensional stability of the material (Papadopoulos & Gkaraveli, 2003). Thus, the strength of particle board unlike conventional wood can be purposefully enhanced by the manufacturer. It may all depend on the chemical composition of the content.

Rowell (1975) revealed that the natural reactivity of lignocelluloses can be utilized to enhance their properties with the resulting material being superior in terms of performance and versatility. This implies that the nature of wood shavings could also be used to enhance the strength of particleboard. Rowell again stated that "The basic types of chemical modification uses simple mono-functional modifying agents while others use dysfunctional, or even poly-functional modifying agents". Thus, the strength of particle board may depend on the manufacturer as well as the purpose for which he intends to use it. Rowell specified that one of the most practical of these is the reaction of a hydroxyl group with acetic anhydride, known as acetylation. To buttress the points asserted earlier,

(Papadopoulos & Traboulay, 2002) reported that recently, acetylation has been successfully employed to improve the dimensional stability of particleboard.

2. Research Design

The principles and ideas of qualitative research methods were the bases on which the researchers rolled out their procedures and strategies. The research design employed was qualitative for gathering information where descriptive and action research were employed.

2.1. Quasi-experimental

It is a research design commonly employed in the evaluation of educational programmes when random assignment is not possible or practical (Gribbons & Herman, 1997). Quasi-experimental shares with all other experiments a similar purpose to test descriptive casual hypothesis about manipulable causes.

This research design like any other experiment focuses on comparing variables to aid analysis of study. Quasi-experimental research methods stated by (Stanley &Campbell, 1963), are the many natural social settings which the researcher can introduce something like experimental design into scheduling of data collection procedures even though he lacks full control over the scheduled experimental stimuli which makes a true experiment possible. It was used in the seasoning and mould preparation stages of the boards. The general work process made use of Quasi experimental in comparing research variables and data collect. This was because the researchers did not have fill control over the scheduled experimental stimuli.

2.2. Action Research

Action research is an interactive process involving researchers and practitioners acting together on a particular cycle of activities including problem diagnosis, action intervention and reflective learning (Avison, 1999). Action research is both a participatory and democratic process concerned with developing practical knowledge in the pursuit of worthwhile human purposes which seeks to bring together action, reflection, theory and practice.

This process is done in collaboration with others in the pursuit of practical solutions to issues of pressing concerns to people and more generally the flourishing of individuals and their communities (Brydon, 2001). Per these definitions, action research aims at a merger between actions and theories framed within time to produce results. It was by this method that research findings were implemented and tested. The researchers after creating the cast left it for a few days to dry before carving to test the materials viability. The researchers used Action research method in the immediate implementation of research findings to answer the objectives of the study.

2.3. Descriptive Research

It is a research design that offers a detailed account of some social phenomena setting experience, group etc. (Ryane, 2005). William (2001) stated that descriptive research depends on observation as a means of collecting data. He further says that observation examines situations in order to establish what the norm is and what can be predicted to happen again under the same circumstances. According to as Asabere (2011) "Descriptive research has the following types: case study, ethnographic studies, exploratory observation studies, among others" (p.14). The researchers aimed at measuring the behaviour of a variable thus, bonded sawdust against wood in order to draw conclusions about similarities or differences between the two. For this purpose, exploratory observation was used.

As stated by Hesse-Biber (2010) these methods are often mixed up to aid the researcher who seeks a convergence of the data collected by all the methods in a study to enhance credibility of research findings. These research methods have the advantage of providing much data relevant to the study and they also clearly address the scope and range of the study.

2.4. Population

Amoh (2009) defined population as a group of people or objects with common characteristics that are of interest to a researcher. Scientific methods of population identification and sampling strategies were applied. Purposive and convenience sampling techniques were employed. Sawmills identified were based on proximity of their locations. The sampled population was also based on a careful selection.

- Target Population

The target population was the group of all sculpture students at Armed Forces Senior High school in Kumasi and indigenous woodcarvers working at the Centre for National Culture, Kumasi, during the period of the research.

Variable	Number
Form One sculpture students	27
Form Two sculpture students	20
Form Three sculpture students	28
Indigenous carvers at Centre for National Culture Kumasi.	12
Total	**87**

Table 1: Sculpture students at the Armed Forces Technical Senior High School, Kumasi and indigenous woodcarvers at the Centre for National Culture, Kumasi.

- Accessible Population

A total of 33 people were involved in both experimentation and production processes. They comprised 28 sculpture three students and 5 wood carvers from the Center for National Culture, Kumasi.

2.5. Sampling Strategy

Sampling is the process of shedding a selected subset of a research population (Raune, 2005). It is also the set of actual data sources that are drawn from a larger population of potential data source (Sage encyclopaedia, 2010).The sampling group was taken out of the accessible group of 33 people.

Okra (2002) explained that purposive sampling is appropriate when one wishes to interview persons who are in a good position to supply information. After identifying the population, purposive sampling was employed because the researchers believed that though each member of the population was potentially capable to provide the needed information, individual differences and character traits could also add to the kind of information a person provides.

3. General Work Procedures and Processes

The materials and tools that were used in the moulding, carving and finishing the project works have been described in this section of the study. The tools and materials include mallet, flat chisels, gouges, sandpaper, stains, white glue, mason polish, lacquer and varnish. Other materials used were plastic container, spatula, brick and a sieve.

3.1. Acquisition and Treatment of Sawdust

The researcher sourced for raw materials needed for the project from sawmills located around Santasi in Kumasi. Acquiring sawdust was easy because sawmills seem to have a problem disposing them off. For this study, the researchers classified the raw materials, that is sawdust into four categories. These are smooth, semi smooth, coarse and semi coarse. The researchers noticed that the sawdust particles collected varied in sizes and colour. It is this characteristic that the researchers used to sort and also name the different groups for the purpose of easy identification. Sawdust collected was sieved through screens of different sizes and eventually grouped according to the different sizes in the preparation for their use as carving materials.

Figure 1 - Smooth sawdust

The researchers first experimented with the finest category of saw dust collected. This category of sawdust with smooth particles at a glance may look very appropriate for board making. Its fine nature suggested the possibility of the particles to interlock during use. In other words, individual particles still stand “on their own” even after bonding. Hence the dried casts are not able to bond well. The end product therefore became brittle. Secondly, it was observed that even though blocks could be made out of smooth sawdust despite its brittle nature, they could be used in making small blocks meant for uncomplicated art works.

Figure 2 - Semi-smooth

It was assumed that they could hold the binder very well. Owing to the fact that the particles were quite bigger, they were assumed to interlock each other very well. Blocks made out of semi smooth sawdust were solid and compact. Its brittle propensity was much minimal compared to the smooth sawdust.

- Coarse and Semi-Coarse sawdust

Figure 3 - Coarse

Figure 4 – Semi-coarse

Both coarse and semi-coarse sawdust particles were observed to have similar reactive properties to bonding. They had a far better bonding ability than the smooth and semi-smooth. They could hold glue very well. Their individual particles interlocked well. However, boards created from coarse and semi coarse sawdust had uneven surfaces as well as large pores in them respectively. They also had haphazardly arranged grains. Board created from this type generally did not have an appealing appearance.

3.2. Making of Sawdust Blocks

- Objective One

The first objective of the work was to experiment and fashion sawdust into blocks and boards to serve as a suitable material for carving. The researchers built sawdust blocks for the carving experiment using wood glue as the main binding agent. A study into the manufacture of particle-board gave the researcher an idea of how manufacturing of particle-board is done.

Basically, particle-boards are manufactured to serve as flooring material and are generally used for carpentry works. This study was intended to produce particle-boards thick enough for carving, thus the manufactured boards were to wield properties similar to wood used for carving. According to Dinwoodie (1989), wood is considered a heterogeneous material that varies in strength. The researchers therefore had the liberty to produce a material suitable for this intent. The aim was to come up with a kind of material capable of withstanding chisel and hammer blows. This type of particle-board was also going to be used for both ‘‘in-the –round’’ and ‘‘relief’’ carving.

Figure 5 - Plastic containers

In the first experiments conducted, the researchers made use of plastic cooking oil containers which were readily available at no cost. With aid of a large pair of scissors, the top parts were cut off leaving a large base as found suitable for the purpose of serving as a mould for the sawdust (see figs. 5-7). The manner in which they were cut gave room to adequately fill them with sawdust for the moulds.

Figure 6 - cutting the container into two

Figure 7 - The prepared containers ready for use

Figure 8 - Sawdust in black polythene bags

Figure 9 - Packing sawdust into a container

These plastics did not allow for lubricants, the researchers had to destroy the mould after the casting process. In other words, removal of the cast from the plastic mould was difficult. Also because the plastics did not allow air penetration, both air and water were trapped in. The researchers then had to improvise ways to deal with this phenomenon. With the help of nails, holes where made all over the plastic containers (moulds). This was to aid the easy escape of both water and air. The researchers further noticed that though both air and water contents were induced out of the mixture, parts of the mixture exposed dried faster than the other pin-holed portions. The researchers resorted to the careful removal of the plastic moulds. This could be done after some days of sun drying to aid a degree of hardening of the cast. Though this procedure had to take place in the "green" state of the cast the removal were carefully done in order not to distort the form of the cast.

3.3. Applying Weight to Mould

Industrialized particle-boards are produced for kitchen furnishing. They are usually compressed with the help of heat. This they do to aid drying and improve compatibility. The researchers on the other hand decided to apply weight, heat and natural air in different ways. One out of the three moulds was heavily compressed with cement block (Figure 10). The first mould was labelled ''A ''

Figure 10 - A heavy cement block used to exert weight

The second mould which was labelled ''B'' was periodically aided to dry with the help of an electronic dryer and the third mould labelled ''C'' was left to dry on its own.

The researchers observed that Mould ''A'' that was compressed with weight immediately started to ''bleed''. The moisture content which was to serve as the binder begun to drip profusely. Due to the enormous loss of the binder and the moisture content, the whole mass became extremely brittle. The intended effect of the binder at this point was not much noticed. Upon drying, the researchers

noticed that even though there was much loss of the binding content at the beginning of the drying process, the completely dried mass appeared compact and it exhibited no sign of binder deficiency.

The second mould that was aided with an electronic dryer also produced a different outcome. The researchers identified that even though the wet mould reacted positively to the application of heat, the effect of the heat only affected the exterior leaving the interior wet. The intensity of heat on the outer layer of the cast appeared to have burnt.

The researchers had to cut through the cross section to be able dry the moisture content trapped inside the mass. Unlike the first cast, the second drying process appeared cumbersome and time wasting. The third cast that was left to dry on its own required a longer drying time. This was because whilst the moisture content of the other cast were forced to dry through exertion of weight and the use of heat, the moisture in the third mould was supposed to dry alongside the solid content.

Figure 11 - Well dried casts 'A' 'B' 'C'

3.4. Carving the Mould

Conventional carving tools were used to experiment the carving of the formed casts. The researchers decided on carving an object in-the-round out of Mould C. Though the material seemed to be comfortable to carve, it also had its challenges. First of such challenges was the effect of grain pattern of the mould. The grain pattern appeared to have been mixed up. Unlike conventional wood for carving, this allowed the material to be properly worked with only with well sharpened tools. The researchers noticed that any tool that appeared not to have been well sharpened splits the individual grains of the mould. The researchers also decided to allow an indigenous carver to experiment with it to give the research a balanced spectrum. Woodcarvers at the National Centre for Culture were engaged in this part of the study.

3.5. The Nature of Wood Carving at the Centre for National Culture in Kumasi.

Carving basically is an expression of indigenous beliefs and philosophies through art (Agyen, 2013). Per the motive behind the establishment of the centre, all artisans are endeavoured to promote Ghanaian culture through their various art works. Carvers at the centre carve traditional expression and philosophies. Even though they try as much as they can to portray cultural diversity through carving, some particular artefacts appeal so much to buyers. Also, some buyers crave for personal interpretation being incorporated in their works. As a result, production of artefacts now depends on customers taste, size of work and season.

Basically, there are two groups of carvers at the Kumasi Centre for National Culture. Even though both groups are indigenous carvers, one group is into drum carving while the other undertakes a general practice of art.

Although these are grouped into two based on their location and kind of practice each carver works on their own. Although apprenticeship goes on here, majority of the carvers are master carvers who have sojourned from elsewhere to practice (ply) their trade at their present locations. For the sake of study, the group that engaged in the general carving practice was suitable to work with. They were made up of five members consisting of four masters and one apprentice.

Even though they practice carving, generally they mostly do jewellery boxes, drums, dolls and Adinkra panelled designs. In as much as they worked individually, they did consult themselves when it comes to work. Each other's expertise had a bearing on the other. They primarily work with some specific wood species for example "Tweneboa" and occasionally Teak. Majority of the raw materials is gotten from Sefwi in the western region. To them timber as a raw material is not close to extinction. Their only concern is that workable species are sited very far in deep forest lands. The researchers used random sampling to select three out of the five master carvers. The researcher believed that each member of the population wielded an equal chance and depth of experience of being selected and hence providing the necessary information needed for the study (see Figure 12).

Figure 12 - Indigenous carvers at the Centre for National Culture Kumasi

Though these carvers have a lot of experience with regards to carving and carving materials, they seemed not to have experience with the carving of particle boards. They were also given the room to operate with no restrictions. They came out with two works. The outcome of their works was very encouraging compared to the amateur disposition of the student carvers. Their finishing did not suggest they had difficulty with it (See Figure 13).

Figure 13 - 'Adinkra' A sawdust carving by carvers at Centre for National Culture, Kumasi.

3.6. Finishing

On the other hand, finishing of the works also came up with its own challenges owing to the seeping nature of the cast. The finishes applied appeared to seep into the material due to its porous build up. Owing to this fact, lacquered as well as varnished works still appeared matt. Nevertheless, the interlacing appearance of the material gives the work a beauty of its own. Since the use of both lacquer and varnish appeared not to have any visible effect on the works, the researchers resorted to staining as a form of finishing.

- Objective two

The second objective was to teach Senior High School students the process of making sawdust boards and blocks and also to design and carve pieces out of the new material.

Figure 14 - A group of students being introduced to the project.

The students had to be given a detailed explanation on what they were about to do and its importance. Their sculpture background made it easier for the researchers to make them understand the concept of the project they were about to undertake.

Figure 15 - Preparing the mixture by adding white glue to sawdust

Though the researchers had prior knowledge of the material, for the sake of the students, they experimented with them through different approaches. This was intended to give them a better understanding of the process they were going through. Firstly, a quantity of undiluted wood glue was added to the mixture. However, undertaking the process revealed that adding a high concentrate of wood glue to sawdust could not produce an even mixture bringing about bumpy lumps. Since the students had knowledge in the preparation of plaster of Paris, a suggestion was made by one of the students. He proposed the process used for plaster of Paris. The mixing process was then changed. This time, small quantities of sawdust were added at a time to a solution of wood glue and water. The ratio of the mixture was three parts of water to one part of glue.

Figure 16 - Preparing the mixture by adding sawdust to glue

Figure 17 - Wooden moulds being lubricated

Lubrication of the moulds was very important. Since the material which was being used for casting was the same as the mould it was likely that the two materials were going to bond together. Using a painting brush, ordinary cooking oil was used to lubricate the moulds. This was done to aid easy separation of the mould from the cast after drying.

Figure 18 - Prepared mixture was packed into well lubricated moulds

Using the hand, the wooden mould was filled with sawdust paste. The paste was compressed to fill every corner of the mould (see Figure 18).

Figure 19 - A well-dressed mixture packed in a mould

At this level, the hand could not help to achieve the smoothness the researchers desired so with the help of a spatula the packed mould was then dressed to give it a smooth and an even surface.

Figure 20 - Bricks were packed on the moulds to exert weight to achieve compactness

One of the prepared moulds was covered with a slice of plywood and a pack of bricks laid on the mould to exert pressure whilst the other mould was left without any exerted weight. The aim was to bring comparison (see figs. 19 and 20), between both on drying speed and at the same time measure the impact of weight on the prepared mould.

Figure 21 - Dried mixture in a mould

After two weeks to allow the mould dry, researchers went back to remove the cast in order to work with it. The cast was taken out of the mould. It was discovered that the mould on which the slice of plywood was placed appeared to have an uneven surface. This was due to the fact that the lubrication did not have the desired effect on the mould. The lubricant appeared to have dried up because of the long period the mould was left to dry. The cast were then forced to be separated from the moulds with the help of chisels. Parts of the moulds had to be destroyed (see figs. 22 to 26).

Figure 22 - A group of students using a chisels to remove a mould

Even though the cast was removed successfully, the difficulty encountered was a major threat to the cast owing to its soft nature.

Figure 23 - Checking of the lubricant's effect on the cast

Figure 24 - Trying to improvise a way to separate the cast from the mould

Figure 25 - Using chisels to remove the casts from the moulds

Figure 26 - Parts of the mould were destroyed in the process

3.7. Working with the Cast

The next task was to carve something out of the sawdust blocks created. The idea was to come up with something basic owing to the students' technical limitation with regards to wood carving. The students were grouped into two. Without any particular order, each of these groups was to come up with something they could carve. The first group decided to work on an Adinkra symbol, whilst the other wanted to carve an inscription.

Figure 27 - Sketching on the boards

With little supervision from the researchers and their sculpture teacher, the students applied their knowledge in wood carving in executing this new task. Though the difference in both conventional wood and the created cast seem not to be much, there were still some technicalities to be critically considered. The colour of the boards did not make pencil marking visible. The students then decided to print their designs on paper, paste it on the board and carve from it directly.

Figure 28 - Testing their hands on the material

The weight of hammer blows in wood carving appeared to vary. Sawdust moulds were not as dense as conventional wood of the same size. The intensity at which a mallet will be used in conventional wood carving also varied. Sawdust moulds could not be carved according to the pattern of their grain movement. This happened because grains were haphazardly patterned.

Figure 29 - Students working on their projects

Carving intricate parts appeared to be challenging. Relief areas that had little attachment to the base of the work were likely to chip off.

Figure 30 - A closer look at the board

It was discovered that unlike conventional wood, portions mistakenly cut off could not be glued back. Relief works did not stand out until either the background or the carved parts were stained.

Figure 31 -Trimming the edges

Figure 32 - Samples 'A' and 'C' Relief carving from sawdust

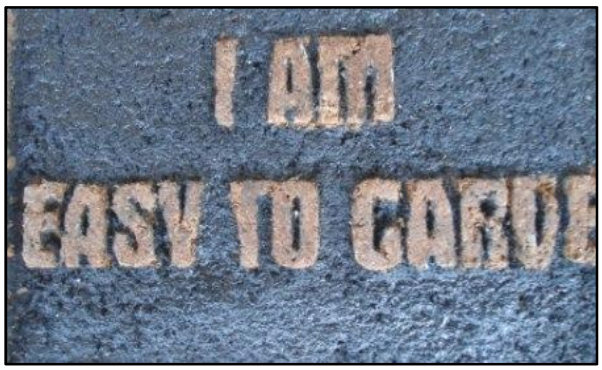

Figure 33 - A finished relief work from sawdust

Figure 34 - 'Up & Down' a relief work carved from sawdust blocks

4. Presentation and Discussion of Findings

Authors presented and discussed findings from the field.

4.1. Observation of smooth sawdust

It has been revealed by experiment that smooth Sawdust does not respond very well to the board making process. Though it reacts well to bonding to some extent, its ability to be carved is the least as compared to the others. The researchers found out that the nature of smooth sawdust retards cohesion even after it is glue bonded. The structural composition of individual particles in smooth sawdust makes them stand apart. Boards made out of smooth sawdust are brittle. Secondly, it was observed that even though blocks could be made out of smooth sawdust despite its brittle nature, they could be used in making small blocks meant for simple art works.

4.2. Observation of Semi-Smooth Sawdust

On the other hand, semi smooth sawdust reacted better to the bonding procedure. They could hold the binder very well. Owing to the fact that the particles were quite bigger, they tended to interlock each other very well. Blocks made out of semi smooth sawdust were solid and compact. Its brittle propensity was much minimal compared to the smooth sawdust.

4.3. Observation of Coarse and Semi-Coarse Sawdust

Both coarse and semi-coarse sawdust particles were observed to have similar reactive properties to bonding. They had far better bonding ability than the smooth and semi-smooth sawdust. They could hold glue very well. Their individual particles interlocked well. However, boards created from coarse and semi coarse sawdust had uneven surfaces as well as large pores in them. They also had haphazardly arranged grains. Board created from this type generally did not have an appealing appearance.

4.4. Findings on the Reaction of Wood Dust from Different Species

Although the researchers started with the aim of using sawdust to create boards regardless of the kinds of wood species the sawdust came from, they had the opportunity to collect sawdust which had dominating proportions suggested to come from a particular wood with regards to their colour, smell and strength. The researchers observed that even though bonding in the context of this experiment depended solely on the glue, the dominance of certain species in a collection either enhanced or retarded the bonding process.

4.5. Yellow Dominated Sawdust

The researchers observed that a collection of yellow dominated sawdust had a very good bonding property. Its compatibility was superior to all the others. They allowed cast to be taken off a day after the mixture was poured into the mould. Blocks appeared solid even when they were freshly prepared and the casts still had high water content.

4.6. White Dominated Sawdust

Even though white sawdust collected bonded well, it had a high brittle property. Its nature made its preparation have a greater dependency on the moulds used. Unlike the yellow sawdust it could take about a week before a board could be ideally removed from the mould. Owing to its brittle nature, the mixture had to be allowed to dry a little bit longer in the mould otherwise they could break if attempt was made to remove the block.

4.7. Effect of both High and Low Concentrates of Wood Glue

The researchers observation of all the experiments carried out revealed that the intensity of white glue solution did not have much bearing on the outcome of the boards. The response of a board built with a high concentrate of wood glue was the same as the one built with a low concentrate of wood glue. It was found not to have any effect on drying time, strength and binding capacity of the blocks.

4.8. The Effect of Water

Water in the whole experiment served as a vehicle which drove both sawdust and glue into a complete mass. However, the researchers observed that the quantity of water used had an effect on the drying time of the cast. The lesser the quantity of water added the mixture, the faster the drying period and vice versa.

4.9. The Effect of Heat

The application of heat does not appear to facilitate a good drying process. Heat was observed to have effect on only the outer parts of the mixture.

4.10. The Effect of Induced Pressure

The study revealed that induced pressure is effective and aids the drying process. The researchers observed that cast on which weight was applied dried faster than the others without weight. Water content in pressured cast drained faster than unpressurised moulds. On the other hand, it was noticed that if lubrication is not intensified, pressured cast stuck to the moulds thereby creating rough cast surfaces.

4.11. Findings on Tools

The researchers observed and found out that the regular tools that are used for woodcarvings could equally be used on bonded sawdust. Though the properties in wood and bonded sawdust are almost the same, tools with sharp cutting edges worked more effectively on sawdust. Blunt tools caused the chipping off of unwanted parts of bonded sawdust during carving than conventional wood.

4.12. Effect of Lubricants

The researchers observed that though lubricants were smeared inside of the moulds, the material still got stuck to the mould in which the blocks were built.

4.13. Finishing

The porous nature of sawdust cast did not allow the carvers to have the desired finishing effect on the work. It appeared that the porosity of the material allowed the applied finishing such as varnish to seep into the work thereby not giving it the gloss effect desired. Carved sawdust pieces do not appeal very well as compared to conventional wood during finishing. However, despite the porous nature of sawdust cast, they also tend to have their own distinct beauty if carefully finished.

5. Appreciation of Works

Figure 35 - "Her face" a lacquered carved piece

5.1. Her Face

"Her face" is a carved piece made from bonded sawdust. The original cast from which the work was carved was composed of semi coarse sawdust particles. It was carved with ordinary carving tools. The piece portrays the face of an African woman. It has been finished by lacquering. The material make-up of the cast gives the work a matt finish adding a unique touch to the work. The nature of the parent material did not allow the carver to bring out more facial details. Hence the viewer may enjoy it better when observed from a distance.

5.2. Interpretation of Results

The work was inspired by the many female figures mostly carved by Ghanaian sculptors. This inspiration brought forth the challenge that if any subject could be experimented with, the African female face with its unique contours and beauty was the best subject for execution. The carver believed that if the female African face could be carved, then the material could be used for any other work.

Figure 36 - "Black mask" a stained carved piece

5.3. Black Mask

Black mask is an African mask carved out of white glue bonded sawdust. The original cast from which the work was carved from was composed of coarse sawdust. It was carved with well sharpened chisels. The work has a scooped back that gives a hollow opening to both eyes. Though it has been finished by lacquering, the finishing still appears to have sipped giving the work a matt appearance. The multi-coloured grain particles gave the work a different sense of beauty.

5.4. Interpretation of Results

The work was inspired by a story told in a local Ghanaian movie. The story tells the disparity between the interpretation given by foreigners and contemporary Ghanaians with regards to carved African mask. Though it is branded evil by most indigenes, foreigners use it as money making objects in foreign museums. This work conveys the message that although most African art pieces are functional, some also have intrinsic aesthetic values.

5.5. Reaction of Local Wood Carvers

- A prior knowledge of the material gave them the idea as to the approach needed to be applied. Hence they remarked that carving without prior knowledge of the material could immensely affect the whole carving process.
- According to the carvers sawdust boards are termite proof and therefore could be better preserved than conventional wood.
- They would not mind to work with it in future provided they will be able to get the sizes they may need.
- They had problems with the manufacturing process. They believe that because of its long drying process, time bound projects could hardly be executed with this material.
- They also commented on the fact that because sawdust boards are made from a combination of dust from different wood species, it is just like carving with conventional wood.
- The material requires well sharpened tools to work with.
- They believe that the challenges they encountered with regards to its finishing dents the general workability of the material.

5.6. Reaction of Students

The researchers could not get so much from the students. This was attributed to the fact that they did not have much experience. However 16 out of the 28 students made the following observations.

- They enjoyed the experience.
- They admitted to have difficulty in carving the material. They however attributed it to inadequate carving experience and blunt tools.

- They did not enjoy the finishing of the work.
- They expressed the interest of using the material again in the future.

6. Conclusions

The result of the study confirmed that bonded sawdust could be used as a substitute material to wood carving. The researchers further recognized that even though pieces could be carved out of moulded sawdust, carved wood pieces are more appealing than carved sawdust. This may be due to its structural make - up and probably its finishing challenges. In terms of durability, sawdust boards may require much careful handling as compared to conventional wood. Despite the fact that the research had positive results, some challenges were encountered. Inconsistent weather pattern was a major setback to the success of the work since the researchers relied on natural elements to dry the moulds; inconsistent weather delayed the work. Lack of adequate practical carving knowledge of Senior High School students also had a toll on the speedy execution of the work.

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